KEER2014, LINKÖPING | JUNE 11-13 2014
INTERNATIONAL CONFERENCE ON KANSEI ENGINEERING AND EMOTION RESEARCH

The Impact of Narrative Methods on Deriving User-Centered Product Requirements from Individual Knowledge

Christian Wölfel

Technische Universität Dresden, Germany, christian.woelfel@tu-dresden.de

Abstract: Industrial design education and practice often sits on the fence between rational approaches as established in engineering design on the one side and free-spirited approaches familiar to fine arts on the other. Especially when in interdisciplinary contexts, this may cause some issues since industrial designers and their methods may be perceived as either too narrow-minded or too chaotic. One example of reoccurring surprise is the use of narrative methods such as personas and use case scenarios in systematic product development processes. Usually, collaborating engineering designers are sceptic in the beginning but later on accept the methods as means of communication and collaboration. However, narrative methods are not only means of team work and presenting concepts or solutions, but also help analysing the task, defining requirements and evaluating design proposals. This paper describes a study that aims at proving the impact of narrative methods in industrial design on an empirical basis.

Keywords: individual design knowledge, narrative methods, user-centered product requirements

1. THEORETICAL UNDERPINNINGS

1.1. Specifics and acquisition of design knowledge

Based on his general definition of design knowledge as “as simply knowledge that can be used to produce designs” (2005: 387), van Aken provides the categories object knowledge, realization knowledge and process knowledge, which can be further classified into prescriptive and descriptive design knowledge. In reference to van Aken’s categorisation, this paper focuses on prescriptive object knowledge.

Prescriptive design knowledge is needed to be able to work on the design task. Individual prescriptive process knowledge may grow from project to project, being applied mostly unconsciously. In contrast, large parts of prescriptive object knowledge must be acquired

specifically for the projects. Consequently, design projects usually start with the designers' individual acquisition of knowledge. Especially to novices, it may be rather complicated to make this knowledge individually available although it is principally and individually already there (Schön, 1983; Goel, 1995). The action regulation theory (e. g., Hacker, 2005) brings forward an explanation model according to which the lack of an anticipatable goal as the crucial foundation of action can be the problem. Before the design goal – in industrial design this is human experiencing (Schifferstein & Hekkert, 2008) – can be anticipated together with the design concept at an abstract level, the designer must be enabled to act during the acquisition of relevant design knowledge by giving further intermediate goals, e.g., as methodical instructions. It is vital that these intermediate goals are defined independently of the task but specifically for the discipline and interact with the other foundations of action, such as motivation.

When methods are selected and adjusted for setting and fulfilling such intermediate goals by the acquisition of individually available design knowledge (in the sense of van Aken's [2005] prescriptive object knowledge), it is vital to take into account its specific characteristics. This knowledge can be described as non-knowledge (e. g. Lawson, 2006, along with uncertainty), previous and experiential knowledge (e. g. Jones, 1963; Cross, 2004), factual and episodic knowledge (Visser, 1995; Lawson, 2004), sociocultural and technical knowledge (Strickfaden, 2006), everyday (e. g. Visser, 2006; Krippendorff, 2006), and expert knowledge (cf. Cross, 2004), tacit and explicit knowledge (Schön, 1992; van Aken, 2005 and many others) and also as objective, subjective and emotional knowledge (e. g. Lawson, 2004; Eckert & Clarkson, 2005). When compared to design knowledge in e. g. engineering design, the focus of design knowledge in experience-oriented design domains is particularly shifted towards socio-cultural, implicit and subjective knowledge, factual and purely professional knowledge play a minor part, on the whole (Wölfel, 2008).

Only few of the methods established in the product development disciplines take full account of these characteristics of design knowledge and hence can assist designers in design knowledge acquisition. Visual, verbal and narrative methods can significantly contribute to the utilisation of portions of unconscious knowledge, the visual methods in particular being already utilised both extensively and intensively in industrial design. As a rule, verbal methods are, even if seldom explicitly perceived as such, also widely used. These methods include sales talks, personnel dialogues, team discussions and presentations, however in a wider sense also brainstorming, brainwriting and less widely used checklists and lists of questions. Narrative methods have been less common in industrial design, yet have gained a certain distribution and acknowledgement in related fields, e.g., in interaction design (Cooper et al., 2007, Pruitt & Adlin, 2006 et al.).

1.2. Narrative methods

In this paper, the focus is on the applicable, however rather labour-intensive narrative methods persona and narrative normative scenarios. The said narrative methods define anticipatable intermediate goals and allow a holistic understanding of the product experience context. This paper aims at discussing the function of narrative methods and at providing proof that these methods actually support industrial design processes.

Storytelling is the oldest and most natural form of knowledge generation (sense making). Storytelling is part of everyday life and an intuitive aspect of vocational practice, it has also been explicitly introduced in some spheres as narrative methods and adapted to actual problems at hand. Moreover, narrative methods are increasingly used as exploration tools in social sciences (Jonassen & Hernandez-Serrano 2002) in particular when experience and meaning are of interest

(Bruner, 1990).

Storytelling is a worthwhile narrative method in business management (e. g. Gabriel, 2000) and is sometimes also used in product development, e.g., for requirements analysis (Gruen, 2000). Using the method of the Grounded Theory (Strauss & Corbin, 2003) knowledge is retrieved through storytelling and can later be verified. The approach is quite intuitive: knowledge and experiences are told as narrations, taken down or represented in a suitable form. That means that stories can describe the objectives and experience of potential users (Gruen et al., 2002). A certain ability and motivation for writing stories is required of course. As Norman (2011) sees it, it professionals in the experience-oriented design disciplines necessarily must have the ability of developing stories in general.

Thomas (2003) points out that experience narratives and also personal stories are only partly suited as a scientific research method to derive generalizable knowledge. For him the key advantage of experience narratives as a research method is their potential to show the unique-ness of individual existences and at the same time the similarities between the existences in different conditions. Stories allow the readers to share the thoughts and feelings of others in situations they would otherwise never experience.

Storytelling is an individual activity and can be done without any particular learning. A proto-col is automatically produced, either as an audio recording or in writing. Although the method can be used by novices, it is expected that it will be employed more successfully with growing experience. It is also possible to use stories in a collaborative process to create, for example, (fictional) environments, situations and artefacts (Dindler & Iversen, 2007). Dubberly (2009) presents the alternation between stories and models as a circular process that has parallels with the principle of hands-on designing. In this process, stories are »verbal artefacts« that are externalised and communicable and that exist explicitly (and have implicit components), while internalisation creates and alters mental models which in turn have an effect on the stories, on the one hand, but also combine implicit and explicit knowledge that can be used for the ongoing design process.

A recent study by Goldschmidt & Sever (2011) provides evidence of the positive effect of texts integrated in the task on the originality of the design of children’s chairs and desk clocks (but not on their feasibility). The authors compare stimulation by texts with visual stimuli and recommend the application in design processes, in particular in the context of training. In the study, texts were given that were both close to the content of the task and also those straying far from the topic at hand; both types of texts generated the same positive effects on the originality of the designs.

Miaskiewicz & Kozar (2011) established the benefits of personas from the angle of practitioners in a multi-level expert panel and had their role evaluated. According to practitioners, the most important benefit of personas is the chance to raise to life potential users and to make their needs and objectives the focus of design processes (instead of self-referential design). Furthermore, the potential of personas to support the ascertainment and prioritisation of product requirements, is very highly valued. This can be regarded as a type of acquisition of design knowledge.

2. RESEARCH APPROACH

2.1. Analysis of the effect of narrative methods on the design process

On the basis of the above specific characteristics of individually available (prescriptive object) design knowledge and also of the suitability of certain individual methods for the acquisition of such

types of knowledge we developed a two-day workshop that aims at supporting knowledge acquisition at the beginning of the design process. This workshop offers an opportunity to develop and analyse narrative scenarios in which personas as prototypical target group representatives are using the products that are being designed. The workshop is herein-after referred to as narrative scenario. The essential components of the workshop are brain-writing, storytelling, certain (narrative) scenario methods such as user stories or a-day-in-a-life, the persona method and visualisation (e. g., *ad-hoc* mood boards). The participants create three ad-hoc personas in both individual and group work and develop a narrative scenario for a typical day of the primary persona without using external data sources and product usage being in the focus of the process. Subsequently, expressions are derived and images are chosen from a provided set of photographs that represent an abstract definition of objectives in simple form (Figure 1).

Figure 1: Derived expressions and selected images as a preliminary stage to the design concept (example)

It is necessary to define measurable criteria to undertake a systematic analysis of the support capacity of narrative scenarios. The aim was to cover not only should self-disclosures made by the users of the method since this has been already investigated (e. g. by Miaskiewicz & Kozar, 2011). Beyond that, relevant variables of the early design stages are of interest. It is hardly possible or even impossible to measure the quality of the design solutions, though this stands to reason, and there are also too many uncontrollable variables. Consequently, the relevant measurements in this study were made in the first design stages including requirements analysis and concept creation. The variables measured there (described in more detail in the paragraphs below) stand in a more direct relation with the intervention, however, they allow conclusions to be drawn about the effect on the whole design process.

The study was conducted *post-ex-facto* in a test-control group setting. A total of 23 students of Industrial Design Engineering participated in the study. As an intervention, the test group took part in the workshop described above as part of the students' first design project. At the time of the study, the participants had already completed four semesters of basic engineering studies and also a course in design theory and basic design courses in freehand drawing and graphic design. Thus

the participants may be viewed as semi-experts in the field of engineering sciences (in particular in mechanical engineering) and as open-minded novices in the field of industrial design.

As part of the design project, students work on an individually set design task on the subjects *gluing* (test group) and *waste* (control group). The structure of the two tasks was the same: a problem space was given within which an actual product for private or commercial use should be designed. The procedure of the semester project was identical except for the intervention.

Students worked on the design task for one semester and went through clarification and analysis, design concept, overall design solution and detailed design. Students not only produce the design and the pertaining illustrative aids, such as models, drawings and renderings, they also write documentations to represent the design task, the design process and the design result. In a cooperative effort students used brainstorming and similar methods to prepare the individual design task and continued this work individually under the supervision of teaching staff. At the beginning of the design project, the intervention group conducted the above described two-day, supervised workshop for the development and assessment of *ad-hoc* personas and narrative, normative *ad-hoc* scenarios in the form of *user stories* as typical daily routines of the primary personas. After the study was complete, the control group was made familiar with the narrative scenarios in another design project.

The participants of the two groups could not be randomly distributed. It was impossible to take into account personal characteristics of the participants and their potential effect on the result. For this reason, the study should be viewed as *ex-post-facto* and the results should be assessed accordingly. As regards the effect of the narrative scenarios, the type and number of the derived requirements and also the completeness level of the created design concepts as *dependent variables* has been determined based on content analysis. Experienced support, certainty of action, objectives and other »soft criteria« were assessed in a standardised questionnaire. The documentations for the design projects were evaluated using qualitative content analysis according to Mayring (2007). For the purpose of measuring the influence of the narrative methods on the acquisition of knowledge in oneself, the requirements made on the design objects and represented in the documentations, were grouped and quantified in a category system.

For the assessment of the completeness of the design concepts we used qualitative content analysis to check if they include crucial components focussing on human experiencing, technical function and specific solution approaches. The concept representations of the design documentations were analysed and grouped according to the three components. Subsequently an assessment was made whether the design goal was sufficiently or completely anticipated at the particular components. On this basis, the design concepts were classified as *missing*, *marginal*, *incomplete*, *effective* and *complete*.

3. STUDY RESULTS

3.1. Impact on ascertained requirements

Figure 2 illustrates the average quantity of requirements identified in the above categories in a graphic representation. The statistical hypothesis test (independent two-sample, two-sided *t*-test) was employed to evaluate the differences. The test shows that the participants of the test group represented highly significantly more requirements in the category *human-subjective* ($p=.008$) and in the category *technical-functional* highly significantly less requirements ($p=.002$). No significant differences were measured in the other categories. The total number of the represented

requirements is almost the same (and again no significant difference). The effect size was estimated using Cohen's d. Accordingly, a mean effect size (d=-.558) has been identified for the category *technical-functional* and for the other statistically significant requirement categories a small effect size only.

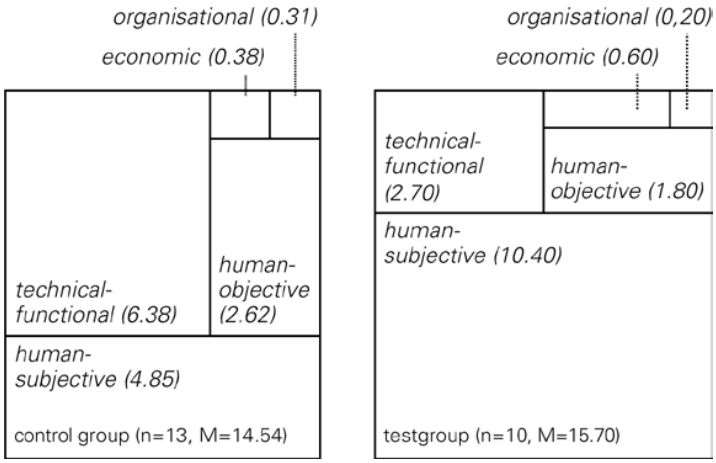

Figure 2: Graphic representation of the mean values of the numbers of obtained requirements per category in the control and intervention group

Figure 3 illustrates the differences in the description of the intended product character in the documentations both of the control and the test group. Beside the larger quantity (variety and frequency of mention of terms) in the test group it can be noted that the participants used more experience-related terms like *confidence*, but also *cheerful* or *calm*, while the control group predominantly used objective target criteria like *small* and *inexpensive*.

Figure 3: Graphic representation of the terms used by the control group (left) and the intervention group (right) to describe the product character in the documentations.
Quantitative representation: size indicates frequency of mention.

3.2. Impact on completeness of the design concepts

The design concepts presented in the documentations were assessed for their completeness. The following figures show examples of concept posters that the participants created as part of the design project and the reviewed documentations. Figure 4 shows the normative description of the product character as a *mood board* that was supplemented with word marks, while the concept poster in Figure 5 rather illustrates the use case since it is influenced by the narrative methods.

Figure 4: »concept poster« for a gluing device (Anonymous 1)

Figure 5: »concept poster« for a gluing device (Anonymous 2)

As can be seen in Figure 6, the share of complete design concepts is only slightly higher in the test group than in the control group. What is even more significant is the clearly smaller number of *missing* design concepts in the test group. The difference in the completeness of the design concepts is – according to a test using the Wilcoxon rank sum test – *statistically significant* (Z=-2.188; p=.029), i. e. the positive effect of the narrative methods on the design concepts is proven.

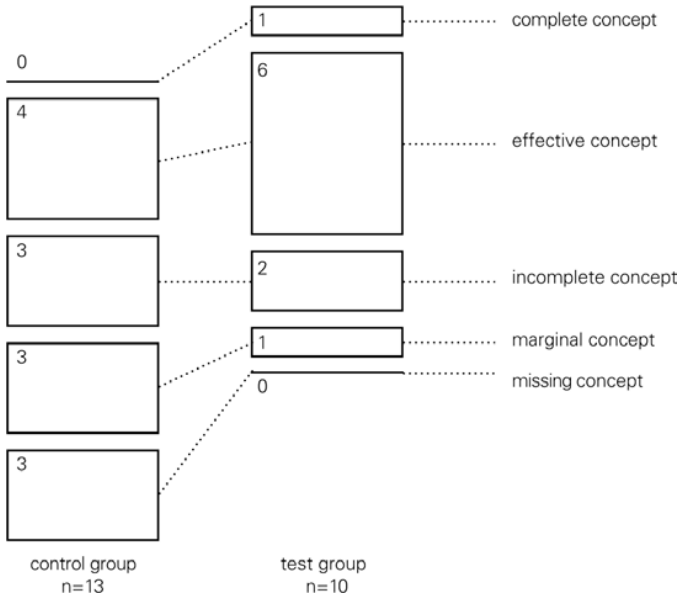

Figure 6: Differences between intervention and control group relating to the completeness of the design concepts

3.3. Support received

During the workshop at nine instants of time, e.g., at the milestones *design concept* and *hypothetical overall design* and also at the end of the design project measurements in terms of lived support, perceived capacity to act etc. were conducted in the intervention group using a standardised questionnaire. All participants in the intervention group tend to evaluate the support function positively (mean ranging between 4.1 and 5.3 on a scale from 0=no support to 6=huge support). *Objective* and *perceived capacity to act* improved during the workshop, which can be

explained by more acquired knowledge and the resulting idea of the design goal.

4. DISCUSSION

The test group ascertained a highly significantly greater number of requirements in the experience-relevant *human-subjective* category. While the control group presented slightly more requirements in the category *technical-functional* than in the category *human-subjective*, the focus of the test group was clearly on experience-relevant requirements. Obviously, this effect was accompanied by a lower number of represented requirements in the category *technical-functional*. The merely small or medium effect size restricts the persuasiveness of the statistical evidence. If we consider the essentially halved or doubled average values, we can assume to have a practical relevance of the differences; however, the relatively large –variance of the measured data reduces the measure of the effect size (Cohen's d). A greater number of participants could bring about a homogenous variance that would conduce to the effect size and could render clearer evidence of the actual effect.

It was also possible to confirm the hypothesis that assumes a relationship between the narrative methods and the completeness of the design concepts despite the small random sample. This serves to confirm the findings of Krzywinski (2012) as well, who identified the elements product character, persona and scenario as constituent elements of design concepts in the slightly different context of transportation design. The Wilcoxon rank sum test, which we employed for testing the hypothesis, has a relatively high robustness to wide data scattering, which has a beneficial effect in this case. In a preliminary analysis using the Median test, a statistical relationship could not be found. A possible reason may be the considerably greater statistical power of the Wilcoxon rank sum test than that of the Median test, because it completely utilises the rank information in the data (Bortz & Lienert 2008).

The restrictions of the quasi-experimental research design and also the small measured effect sizes cannot be taken as »hard facts« that could be used as an argument in favour of using narrative methods or the workshop developed from them. Another analysis under controlled conditions and with a more representative random sample is vital to reliably preclude alternative explanatory approaches for the measured and described differences. It should be examined whether it is possible to qualitatively understand the output of persona and narrative scenario methods, how they influence the design process and how they can be identified in the major stages of the design process.

One of our findings is that the narrative methods *persona* and *scenario* or *user story,* respectively, can be used beneficially in industrial design and are valued by students. Thus it can be stated that both function and effect of the methods can be transferred from interaction design to industrial design. The methods are well accepted as training tools both by the teaching staff and students: almost all students used personas and scenarios in follow-up projects – to varying degrees – without being asked to do so. This complements the findings Krzywinski (2012) made in explorative studies in training programmes in *transportation design* where he identified persona and scenario as effective tools for the creation of experience-based design concepts.

There is evidence that the acquisition of design-relevant knowledge by novice students of design engineering can be improved by employing narrative methods. The study did not cover whether the methods served to improve specific types of knowledge – e.g., episodic or tacit knowledge. This would at least in part be a tautological conclusion since the methods were chosen and employed

just because of their particular suitability to support the acquisition of these types of knowledge.

REFERENCES

Blessing, L. T. M., & Chakrabarti, A. (2009). DRM, a Design Research Methodology. London: Springer.

Bortz, J., & Lienert, G. A. (eds.). (2008). Kurzgefasste Statistik für die klinische Forschung: Leitfaden für die verteilungsfreie Analyse kleiner Stichproben. Berlin, Heidelberg: Springer.

Bruner, J. (1990). Acts of Meaning. London: Harvard University Press.

Cooper, A., Reimann, R. & Cronin, D. (2007). About face 3: The essentials of interaction design. Indianapolis: Wiley.

Cross, N. (2004). Expertise in Design: an overview. Design Studies, 25, 427–441.

Dindler, C., & Iversen, O. S. (2007). Fictional Inquiry – design collaboration in a shared narrative space. CoDesign, 3(4), 213–234. doi:10.1080/15710880701500187

Dubberly, H. (2009). Models of Models. Interactions, 16(3), 54–60.

Eckert, C., & Clarkson, J. (2005). The Reality of Design. In J. Clarkson, & C. Eckert (Eds.), Design process improvement: A review of current practice (pp. 1–33). London: Springer.

Goel, V. (1995). Sketches of thought. Cambridge, Mass.: MIT Press.

Goldschmidt, G., & Sever, A. L. (2011). Inspiring design ideas with texts. Design Studies, 32(2), 139–155. doi:10.1016/j.destud.2010.09.006

Gabriel, Y. (2000). Storytelling in organizations: Facts, fictions, and fantasies. Oxford: Oxford Univ. Press.

Gruen, D. (2000). Stories and Storytelling in the Design of Interactive Systems. In W. A. Kellogg & D. Boyarski (eds.), DIS2000. Designing Interactive Systems, Processes, Practices, Methods and Techniques. New York: Association for Computing Machinery.

Gruen, D., Rauch, T., Redpath, S., & Ruettinger, S. (2002). The Use of Stories in User Experience Design. International Journal of Human-Computer-Interaction, 14(3&4), 503–534.

Hacker, W. (2005). Allgemeine Arbeitspsychologie: Psychische Regulation von Wissens-, Denk- und körperlicher Arbeit. Bern: Huber.

Jonassen, D. H., & Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. Educational Technology Research and Development, 50(2), 65–77. doi:10.1007/BF02504994

Jones, J. C. (1963). A Method of Systematic Design. In J. C. Jones, & D. Thornley (Eds.), Conference on Design Methods. Oxford: Pergamon.

Krippendorff, K. (2006). The semantic turn: A new foundation for design. Boca Raton: CRC Taylor & Francis.

Krzywinski, J. (2012). Das Designkonzept im Transportation Design: Einordnung, Analyse und zukünftige Anwendung. Dresden: TUDpress.

Mayring, P. (2007). Qualitative Inhaltsanalyse: Grundlagen und Techniken (9th ed.). Weinheim: Beltz.

Miaskiewicz, T. & Kozar, K. A. (2011). Personas and user-centered design: How can personas benefit product design processes? Design Studies, 32(5), 417–430. doi:10.1016/j.destud.2011.03.003

Norman, D. A. (2011). Why Design Education Must Change. form: The Making of Design, (238), 92–95.

Pruitt, J. S., & Adlin, T. (eds.) (2006). The persona lifecycle: Keeping people in mind throughout product design. Amsterdam: Morgan Kaufmann/Elsevier.

Schifferstein, H. N. J., & Hekkert, P. (eds.) (2008). Product experience. Amsterdam: Elsevier.

Schön, D. A. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Schön, D. A. (1992). Designing as Reflective Conversation with the Materials of a Design Situation. Research in Engineering Design, 3, 131–147.

Strauss, A. L., & Corbin, J. M. (2003). Basics of qualitative research: Techniques and procedures for developing grounded theory. Thousand Oaks: Sage Publ.

Strickfaden, M. (2006). (In)tangibles: Sociocultural references in the design process milieu. Doctoral Thesis. Edinburgh: School of Design and Media Arts, Napier University.

Thier, K. (2006). Storytelling: Eine narrative Managementmethode. Arbeits- und organisationspsychologische Techniken. Heidelberg: Springer Medizin.

Thomas, R. M. (2003). Blending qualitative & quantitative research methods in theses and dissertations. Thousand Oaks, Calif: Corwin Press.

van Aken, J. E. (2005). Valid knowledge for the professional design of large and complex design processes. Design Studies, 26, 379–404.

Visser, W. (1995). Use of episodic knowledge and information in design problem solving. Design Studies, 16, 171–187.

Visser, W. (2006). The Cognitive Artifacts of Designing. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Wölfel, C. (2008). How Industrial Design Knowledge Differs from Engineering Design Knowledge. In A. Clarke, M. Evatt, P. Hoghart, J. Lloveras, & L. Pons (eds.), New Perspectives in Design Education (pp. 222–227). Barcelona: Institution of Engineering Designers; The Design Society.

BIOGRAPHY

Christian Wölfel studied industrial design at Technische Universität Dresden and Burg Giebichenstein University of Art and Design. He completed his PhD thesis in 2011. Since 2005, he is research associate at the Center for Industrial Design at Technische Universität Dresden, he is also visiting lecturer at OTH Regensburg. He teaches and researches in design fundamentals and design theory. In applied research, he specializes in industrial goods and medical devices.